A Low Power Terabit Laser-Modulator Array, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Technical abstract: Ultra scale computing for large-Scale Numerical Simulation requires a new technology for optical communication. VCSELs run out of bandwidth at 56 Gb/s PAM4, and the latency of PAM4 is incompatible with super-computing. Other available technologies are excessively expensive, have high power consumption, are far from proven or they require temperature control. The proposed concept integrates an Electro-Absorption Modulator (EAM) with a Surface-Emitting (SE) laser capable of > 100 Gb/channel NRZ which can be arrayed to > 1 Tb/s for a 10 element array. Using NRZ instead of a more complex format reduces latency dramatically. The proposed device can operate over a wide temperature range, at least 25 C to 125 C and potentially over the full military range without temperature control. The EAM SE laser has a 30% reduction in power per bit compared to VCSEL solutions, and the transmission distance is dramatically improved. The proposed low cost device can be manufactured by the billions. The EAM SE laser array can be flip-chip mounted onto silicon.. This unique device has ten times the reach of VCSELs, more than sufficient for any data center or super computer. The EAM SE laser is made from elements which are already proven and understood, but put together in a manner which achieves the performance ultra-scale computing needs.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Potential NASA Applications The proposed EAM SE laser solves the latency, bandwidth, footprint, and power consumption problems of optical communications in ultra scale computing and super computing which are vital to the success of NASA?s mission. In adddition LAN?s and MAN?s can also use the technology because of its substantial range. The device will be flip chip mounted on silicon and it has a temperature range of at least 25C to 125 C so it can

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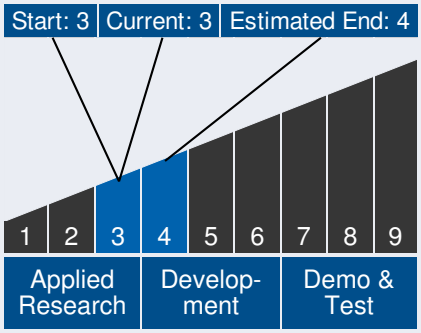
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

handle the heat load which an array encounters on top of silicon driver circuitry. The > 1 Tbps data rates and compact EAM SE laser arrays reduce the number of fiber cores, which have become prohibitive with current VCSEL technology.. The radical approach of the EAM SE laser solves difficult and profound problems with current optical communication technologies using already understood elements. The EAM SE laser can be put into high volume production quickly.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Potential non NASA Applications The proposed EAM SE laser operates over a temperature range of at least 25 C to 125 C, provides low latency NRZ > 1Tbps data transmission for a 10 element array. The low cost device has minimal power consumption, is compact, has range more than sufficient for communication across a data center, MANs, LANs or as short as chip to chip, and is easily integrable on silicon by flip chip bonding and provides vertical light emission. The technologies used in this device are proven, but the elements are put together using design choices optimized for low power, ultra-high speed low latency communication. These characteristics make this device ideal for super computing, large data centers, chip to chip communication, LANs and MANs with a short time to market given sufficient resources. In the long term, the array elements may be used by the hundreds in small scale computing in products such as PCs and smart devices resulting in total volumes approaching one trillion devices.

Management Team *(cont.)*

Principal Investigator:
- Ralph Johnson

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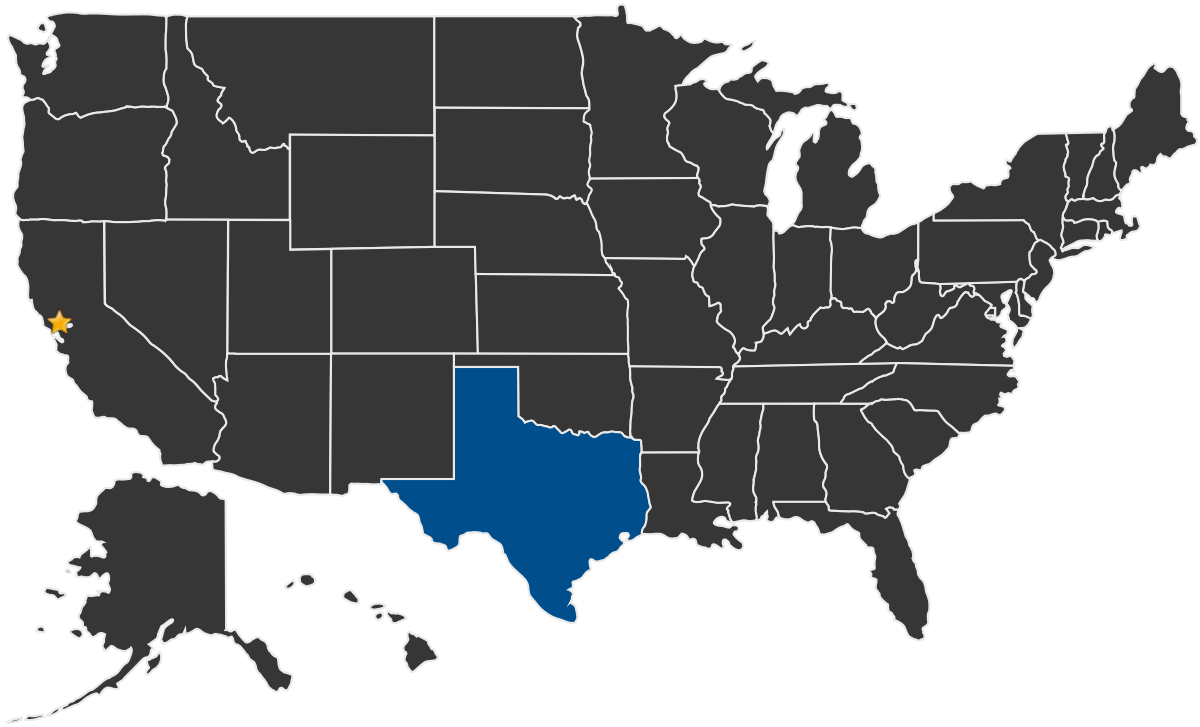
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Ames Research Center

Other Organizations Performing Work:

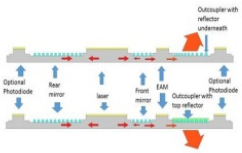
- Photon Sciences, Inc. (Plano, TX)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23317)

IMAGE GALLERY



A Low Power Terabit Laser-Modulator Array, Phase I

DETAILS FOR TECHNOLOGY 1

Technology Title

A Low Power Terabit Laser-Modulator Array, Phase I

Potential Applications

Potential NASA Applications The proposed EAM SE laser solves the latency, bandwidth, footprint, and power consumption problems of optical communications in ultra scale computing and super computing which are vital to the success of NASA?s mission. In adddition LAN?s and MAN?s can also use the technology because of its substantial range. The device will be flip chip mounted on silicon and it has a temperature range of at least 25C to 125 C so it can handle the heat load which an array encounters on top of silicon driver circuitry. The > 1 Tbps data rates and compact EAM SE laser arrays reduce the number of fiber cores, which have become prohibitive with current VCSEL technology.. The radical approach of the EAM SE laser solves difficult and profound problems with current optical communication technologies using already understood elements. The EAM SE laser can be put into high volume production quickly.